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CHARACTERISTICS OF APPLICATION SOFTWARE MAINTENANCE.(U)
DEC 76 B P LIENTZ, E B SWANSON, G E TOMPKINS N00014-75-C-0266

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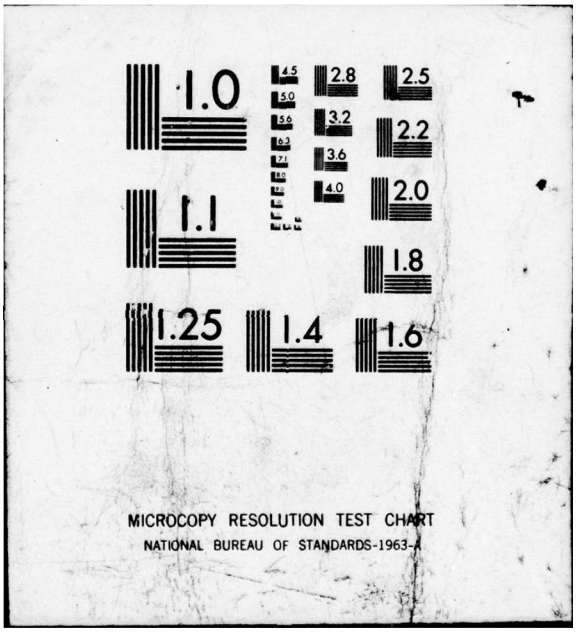
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Characteristics of Application Software Maintenance*

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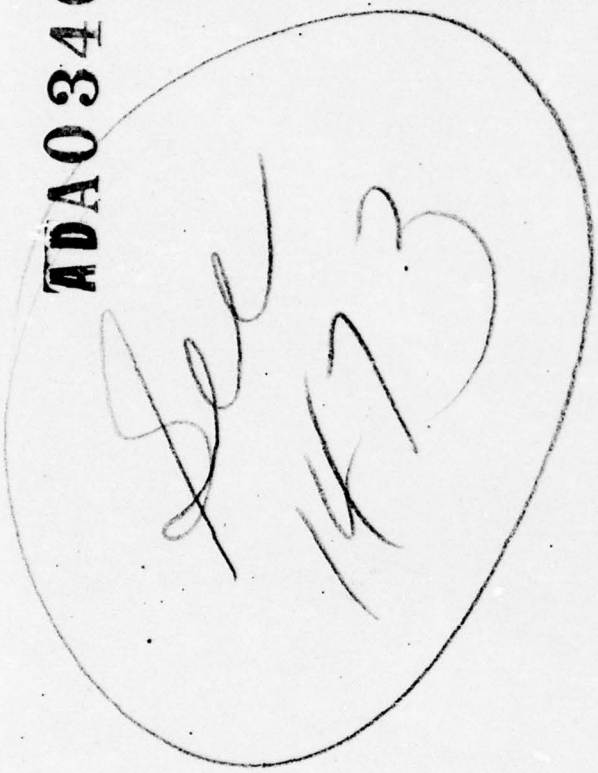
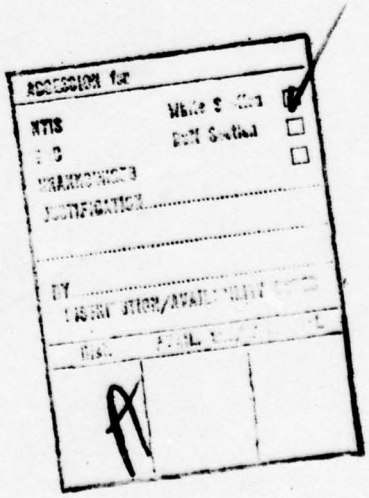


* This work was partially supported by the Information Systems Program, Office of Naval Research under contract N00014-75-C-0266 under project number NR 049-345.

ABSTRACT

Maintenance and enhancement of application software consume a major portion of the total life cycle cost of a system. Estimates of the total systems and programming resources consumed range as high as 75-80% in each category. However, the area has been given little attention in the literature. To analyze the problems in this area a questionnaire was developed and pretested. It was then submitted to 120 organizations. Respondents totaled 69. Responses were analyzed using the SPSS statistical package. The results of the analysis indicate that 1) user demands for enhancements and extensions constitute the major perceived problem area; 2) problems of a management nature are viewed in general as more significant than technical problems; 3) the use of technical productivity aids remains limited; however, maintenance programmer productivity is not considered by management to be a major problem.



1. Introduction

The maintenance and enhancement of operational application software systems is frequently viewed as a phase of lesser importance than the design and development phases of the system life cycle. Maintenance and enhancement are generally defined as activities which keep systems operational and meet user needs (see for example Riggs [16]). Types of maintenance and enhancement activities have been developed in Swanson [18]. This work will be referred to later in more detail.

There have been a number of estimates of the amount of effort that goes into maintenance and enhancement. Riggs [16] cites a range of 40-60% of total systems and programming resources. Similar figures have been given in [3], [5], [7], [19]. An estimate as high as 75% of resources has been cited in [15]. A more conservative estimate of 40% has been given in [8], [9], and by Boehm [2]. Some of the specific problems in maintenance and enhancement have been the effect of hardware changes (Boehm [2]) and errors introduced with modifications (Kosy [10]).

Studies involving specific software systems include Stearns [17] and the excellent analysis of OS/MVT by Belady and Lehman []. Some interesting ideas on maintenance have been stated by Brooks ([4]). Other sources which take a management and implementation point of view include [6], [12], and [13].

The purpose of this paper is to present some of the analysis results of a survey of organizations involved in maintenance and enhancement. Section 2 presents the data collection process employed and a profile of respondents. The statistical results appear in section 3. Conclusions are given in section 4.

2. Data Collection

This section summarizes the data collection process as well as the general profile of respondents. The questionnaire appears in [11].

The process of data collection began with the construction of an initial questionnaire and a field test of five organizations. Refinements were made and the form used for the survey finalized. Some 120 organizations were contacted by telephone to identify the proper recipient of the questionnaire and their willingness to participate. Questionnaires were then mailed out with return envelopes and postage supplied. Follow-up calls were made if no response was received within two weeks. The total number of responses was 69. This is a substantial percentage considering the length and the depth of the questionnaire.

The questionnaire is composed of two parts. Part I deals with the systems and programming department and contains 12 questions in the following areas:

- industry category
- annual budget for software and hardware
- number of personnel in department (systems analysts and programmers as well as aggregate)
- division of tasks among staff in maintenance and new application work, and in analysis and programming
- management structure
- current precentage of effort in maintenance

- relative importance of maintenance compared to development
- reallocation of effort between maintenance and development, given hypothetical budget increases and decreases
- evaluation of adequacy of current levels of staffing

The second part of the questionnaire deals with the application software undergoing maintenance and enhancement. Respondents were asked to select a system which has been operational for at least one year, represents a significant investment of time and effort, and is of fundamental importance to the organization. For this system they answered 38 questions on the following topics:

- name of system, function, and end users
- number of personnel in user groups*
- number of personnel in user groups actively involved in the system processing cycle*
- date system became operational
- number of programs maintained and number of source language statements broken down by language*
- distribution of source statements according to origination year*
- percentage of system dealing with on-line processing*
- total number of machine language statements*
- hardware/software environment of system
- use of distributed processing and/or data base managements systems
- number of files, average size of data base*, percentage of data base updated by time period*

- number and form of predefined user reports*
- productivity tools used in development
- time spent on maintenance*
- division of effort among types of maintenance activities*
- percentage of maintenance effort on on-line programs and in communication with user*
- number of people involved in maintenance of the system, the levels of their programming experience, when they began to work on the system, and task allocation in terms of analysis and programming
- formal procedures for maintenance request handling, number of requests received
- formal procedures for making changes to programs, and number of changes made
- formal procedures for trouble reporting
- existence of auditing, documentation, cost accounting procedures and chargeback methods
- problem areas in maintenance of the system

In the above list, for the items marked with an asterisk (*) the respondents also answered the question: "Check the applicable statement: the above answer is: __ reasonably accurate, __based on good data; __a rough estimate, based on minimal data, or __an estimate, not based on any data."

3. Analysis Results

This section is organized into the following categories: profile of respondents, tools and techniques employed, evaluation of maintenance, and interelationship of variable.

Profile of Respondents

Each respondent was asked to indicate the industry segment of their organization. A classification of the responded indicated manufacturing - 27 (39.1%) and nonmanufacturing - 42 (59.4%).

Several questions were asked of their data processing equipment and annual cost. The response on equipment was similar to the division of the market and was IBM (73.9%), Burroughs (8.7%), Honeywell (5.8%), NCR (4.3%), Univac (4.3%), and others (2.8%).

The distribution of annual budget for hardware is given in Table I.

TABLE I: BUDGET DISTRIBUTION FOR EQUIPMENT

Budget ($1,000's)	Percentage
Under 250	14.5%
250 - 500	15.9
500 - 1000	14.5
1000 - 2000	11.5
Over 2000	40.6

Several questions were asked on how development and maintenance effort would be redistributed if the systems and programming staff were increased or reduced by certain percentages. The results are summarized below (Table II) and indicate that most additional resources would go to new development. Also as expected, most budget reductions would occur in new development.

TABLE II. EFFECT OF BUDGET DIFFERENCE

Budget Change	Distribution of Change				
	New Development		Maintenance and Enhancement		Other
	Mean	Std. Dev.	Mean	Std. Dev.	
10% Increase	6.6%	3.4%	3.1%	3.3%	.3%
25% Increase	15.6	6.7	8.3	6.2	1.1
10% Decrease	7.3	3.3	2.4	3.3	.3
25% Decrease	17.1	6.6	6.8	6.5	1.1

In this table the size of the standard deviation is somewhat unexpected. From the questionnaire data it appears that with a 10% increase there are some organizations which would budget the entire increase for maintenance and enhancement. At the 25% level this group would allocate more to new development.

One major management issue involving maintenance centers on methods for charging back costs to the user. Of the sample almost 60% (59.4%) do not charge back the use for operations or for maintenance and enhancement work. Of the respondents using a charge-back method 90% chargeback both computer and personnel expenses.

Questions of budgeting levels lead to the issue of adequacy of staffing levels. Most felt that they were somewhat understaffed. The reponses were:

Substantially understaffed	8.7%
Somewhat understaffed	60.9
Properly staffed	26.1
Somewhat overstaffed	4.3

Several observations can be made on the organization of the respondents. When asked for a breakdown between analysts and programmers, most respondents have staff members assigned to both maintenance and enhancement as well as new development work. Programming is treated as a separate activity by only 40.6% of respondents.

Of the respondents 68.1% treated maintenance and enhancement as a separate activity from development. In terms of annual personnel hours allocated to maintenance and enhancement, and new development, the results were:

Maintenance and enhancement	48.0%
New development	46.1
Other activities	5.9

This is among the lower estimates for maintenance effort cited in the literature. However, there were a significant number of cases (over 20%) tht allocated 85% of their effort to maintenance.

Within the maintenance effort the breakdown given was:

Category	Activities	Relative Frequency
Corrective	Emergency fixes, routine debugging	17.4%
Adaptive	Accommodation of changes to data inputs and files, and to hardware and system software	18.2%
Perfective	User enhancement, improved documentation, recording for computational efficiency	60.3%
Other		4.1%

In this setting perfective maintenance is by far the biggest area of effort. This will be further supported later in Table V which indicates that user demands for enhancements and extensions are perceived by management to be the biggest problem.

Several questions were asked on accounting for user requests and system problems as well as auditing. It was found that 68.1% logged and documented maintenance and enhancement requests. A lower percentage (55.1%) logged and documented operational problems with the application system. When asked whether a formal audit of the application system is made periodically, only 37.8% responded yes.

Tools and Techniques Employed

Respondents were asked to distribute the percentages of source code lines by language. As expected, the preponderance was in COBOL and Assembler. The distribution was:

COBOL	58.1%
Assembler	18.5%
RPG	10.2%
PL/I	3.1%
FORTRAN	2.6%
ALGOL	1.5%
Other	6%

A somewhat frequently made assertion in the literature is that productivity tools in design and programming are not yet widely employed in practice. This is substantially borne out in the percentages given in Table III. In Table III the most frequently used tool is decision tables (46.4%). Other tools in use by at least 30% of respondents included test data generators, on-line programming and chief programmer teams. It is interesting to note that approximately one quarter of the sample indicated that they use structured programming. Responses other than those in Table III include modular programming, top-down testing, on-line simulator, copy library, and technical design review. It should be noted that the percentages from Table III reflect operational application systems; for systems currently being developed the figure might be somewhat higher.

In several related questions few of the respondents indicated use either date base management systems (21.7%) or distributed processing (4.3%).

Interestingly, maintenance programmer productivity is not regarded by management as a significant problem, as will be shown later. This would seem to indicate that movement toward a widespread use of productivity aids will continue to be slow.

Evaluation of Maintenance

The respondents were asked to contrast the relative importance of maintenance with new system development within their organizations. The relative frequency appears in Table IV. It indicates most view maintenance as more important than new development. More strikingly, few view new system development as more important.

TABLE III. USE OF DESIGN AND PROGRAMMING AIDS

Tool	Relative Frequency	
	Yes	No
Decision Tables	46.4	53.6
Test data generators	36.2	63.8
Chief programmer team	30.4	69.6
On-line programming	30.4	69.6
Data base dictionary	26.1	73.9
Structured programming	24.6	75.4
Structured walk-thru	17.4	82.6
Automatic flowcharting	10.1	89.9
HIPO	7.2	92.8
ISDOS (Automated design aid)	4.3	95.7

TABLE IV. IMPORTANCE OF MAINTENANCE COMPARED TO NEW SYSTEM DEVELOPMENT

Maintenance and Enhancement	Percentage
By far more important	33.3%
Somewhat more important	21.7
Equal importance	34.8
Somewhat less important	5.8
By far less important	4.3

Respondents were further asked to rank possible problem areas in maintenance. This is summarized in Table V. The table columns are arranged by problem area, statistics, and relative frequency. The statistics are based on the coding: 1-not a problem, 2-somewhat minor problem, 3-minor problem, 4-somewhat major problem, 5-major problem. Items marked with an asterisk indicate technical problem areas.

TABLE V. PROBLEM AREAS

Rank	Problem Area	Statistics			Relative Frequency					
		Mean	Median	Std. Dev.	Not Prob.	Somewhat Minor	Minor	Somewhat Major	Major	No Resp.
1.	User demands for enhancements, extens.	3.42	3.72	1.25	7.2	20.3	11.6	36.2	18.8	5.8
2.	Quality of syst. docum.*	2.99	3.03	1.33	17.4	15.9	26.1	20.3	14.5	5.8
3.	Competing demands on maint. personnel time	2.95	3.00	1.39	17.4	24.6	8.7	29.0	13.0	7.2
4.	Quality of original programs*	2.94	2.92	1.42	20.3	18.8	18.8	18.8	17.4	5.8
5.	Meeting scheduled commitments	2.79	2.73	1.21	14.5	26.1	21.7	21.7	7.2	8.7
6.	Lack of user understand. of syst.	2.66	2.53	1.19	17.4	29.0	21.7	20.3	5.8	5.8
7.	Availability of main. program. personnel	2.66	2.53	1.27	20.3	26.1	21.7	17.4	8.7	5.8
8.	Adequacy of syst. design spec.*	2.52	2.3	1.37	29.0	21.7	17.4	14.5	10.1	7.2
9.	Turnover of mainten. personnel	2.46	2.13	1.46	36.2	17.4	13.0	15.9	11.6	5.8
10.	Unrealistic user expectations	2.45	2.50	1.18	26.1	20.3	29.0	13.0	4.3	7.2
11.	Processing time of system*	2.31	2.00	1.33	36.2	20.3	13.0	17.4	5.8	7.2
12.	Forecast. personnel requirements	2.30	2.03	1.28	33.3	23.2	13.0	17.4	4.3	8.7
13.	Skills of maint. personnel*	2.20	1.94	1.24	34.8	26.1	15.9	10.1	5.8	7.2
14.	Changes to hardware and software*	2.14	1.97	1.10	34.8	26.1	20.3	11.6	1.4	5.8
15.	Budgetary pressures	2.09	1.82	1.18	37.7	27.5	11.6	13.0	2.9	7.2
16.	Adherence to program. stds. in maint.*	2.08	1.94	1.04	34.8	26.1	23.2	7.2	1.4	7.2
17.	Data integrity*	2.06	1.88	1.12	34.8	29.0	20.3	1.4	5.8	8.7
18.	Motivation of maint. personnel	2.03	1.82	1.10	37.7	27.5	17.4	7.2	2.9	7.2
19.	Applic. run failures*	2.00	1.90	.92	29.0	44.9	13.0	5.8	1.4	5.8
20.	Maint. programming productivity	2.00	1.87	.97	33.3	33.3	15.9	8.7	0	8.7
21.	Hardware and software reliability*	1.91	1.76	.94	37.7	33.3	14.5	7.2	0	7.2
22.	Storage requiremts.*	1.88	1.34	1.24	55.1	11.6	13.0	8.7	4.3	7.2
23.	Mgmt. Support of system	1.87	1.41	1.17	49.3	17.4	11.6	8.7	2.9	10.1
24.	Lack of user interest in system	1.86	1.58	1.06	44.9	29.0	11.6	5.8	2.9	5.8

The predominant problem cited as more than minor is that of user demands for enhancements and extensions. Following this are two technical issues (quality of original system and its documentation) and one management issue (competing demands for personnel time). Frequently mentioned problems such as hardware change, turnover of maintenance personnel, and motivation of maintance personnel showed up surprisingly low (means of 2.14, 2.46, and 2.03, respectively).

In addition to the twenty-four areas that are mentioned in the questionnaire, respondents were encouraged to list other problem areas. Areas mentioned included quality of operations personnel, turnover in user organization, high learning curve due to large system, and retaining personnel at implementation time.

It is of interest to determine if management issues are more important than technical issues. This would serve as a guide in efforts to improve the maintenance procedures and tools. Statistical tests indicate that management problems are more significant. To carry out the tests for each respondent, the average rating was computed for technical and management areas for each respondent. The Mann Whitney-Wilcoxan and sign tests were selected to test the hypothesis that the distribution of the average response of each category was the same. These tests do not depend on actual scores but relative ratings. For the Mann Whitney-Wilcoxan test the hypothesis was rejected at the $\alpha = .10$ level. For the sign test it was rejected at the $\alpha = .01$ level. Both results indicated higher values for the management areas.

A second hypothesis is that the response to the problem of user demands for enhancement and extension is significantly larger than average for all problem areas. The same nonparametric tests were applied and the hypothesis of the same distribution was rejected at the $\alpha = .10$ level. This indicates user demands are more of a problem than other areas.

As was mentioned in Section 2, some of the questions were followed by questions on the quality of data on which the answer was based. The results are summarized by average and relative frequency in Table VI. An asterisk indicates technical subjects. A question here is whether there is less data available for management type questions than for technical type questions. The results indicates respondents had firmer data for technical management types of questions. The statistical test was to test that the average responses to the management question are based on data of a quality average equal to that of responses for technical questions. The nonparametric tests applied were the sign test and the Mann-Whitney Wilcoxan test. Both tests rejected the hypothesis at the $\alpha = .10$ level.

Similar tests (at $\alpha = .10$ level) indicated that respondents knew more about effort in maintenance and enhancement in general than specific tasks within maintenance and enhancement.

TABLE VI. QUALITY OF DATA AS BASIS FOR RESPONSE

Question Topic	Answer Based on: Reasonably Accurate Data	Minimal Data	No Data	Other
Total mach. lang. statements*	13.0	21.7	26.1	39.1
Distrib. of source code overtime*	46.4	29.0	18.8	5.8
No. of source lang. statements*	46.4	24.6	18.8	10.1
% personnel in input/output	49.3	26.1	14.5	10.1
% time period update data base*	14.5	11.6	2.9	71.0
Size of data base*	53.6	21.7	13.0	11.6
No. personnel in user organ.*	53.6	29.0	11.6	5.8
% hrs. by activity in maintenance	49.3	37.7	8.7	4.3
% hrs. for user commun. in mainten.	46.4	36.2	13.0	4.3
Hrs. spent on maintenance	62.3	29.0	4.3	4.3
Form, freq. of user reports*	65.2	18.8	7.2	8.7
Number of user reports*	69.6	21.7	5.8	2.9
% of statements used in on-line process.	81.2	7.2	10.1	1.4
Lang. used*	81.2	10.1	5.8	2.9
No. programs*	85.5	13.0	0	1.4
% hrs. for maintenance of on-line programs	82.6	11.6	2.9	2.9

*Indicates question of a technical nature.

Interrelation of variables

The previous subsections of this section were concerned with responses to individual questions. This subsection examines the responses for interrelationships between response items.

The analysis indicated that system characteristics, unit maintenance time and other factors are not highly correlated. Weighted maintenance time is measured as personnel time in maintenance and enhancement divided by the total number of source statements maintained. The highest correlations obtained were between the number of programs in the system and the number of predefined user reports on a daily basis (correlation coefficient of .69) and between the number of predefined user reports and unit maintenance time (correlation coefficient of .58). The factors included in the correlation included unit maintenance time, number of personnel in user units, percent of primary users engaged in input/output, size of data base, number of files, number of programs, number of predefined user reports (total and daily), date system became operational, and percentage of time spent in communication with user. Multiple regression and principal component analysis were attempted with the dependent unit maintenance time. The variables were added stagewise in the following order: number of predefined user reports, number of personnel in primary user units, number of programs, and date the system became operational.

It has been suggested that after a system becomes operational, the percent of effort in emergency fixes and routine debugging declines with time. It then increases as enhancement work changes the system and declines. Some support for this was found in the regression analysis.

4. Conclusions

From the analysis of the survey data several tentative conclusions are suggested. It should be emphasized that these are based on the limited sample. The conclusions are:

- Maintenance and enhancement consume much of the total resources of systems and programming groups.
- Maintenance and enhancement tend to be viewed by management as at least somewhat more important than new application software development.
- In maintenance and enhancement, problems of a management orientation tend to be more significant than those of a technical orientation.
- User demands for enhancements and extensions constitute the most important management problem area.
- The use of productivity aids in application software development remains limited. However, maintenance programmer productivity is not considered by management to be a major problem.

Overall more attention should be given to management problems associated with maintenance. In practice, maintenance work should be categorized to permit the gathering of more detailed management information. Project reporting systems should be detailed with respect to the type and tasks of maintenance and enhancement.

The handling of user request for enhancements should be examined to determine means of better evaluating and satisfying requests.

References

[1] Belady, L.A. and M.M. Lehman, "The Evolution Dynamics of Large Programs". IBM Scientific Report, September, 1975.

[2] Boehm, B.W. "The High Cost of Software". Proc. of Symposium on High Cost of Software. Monterey, California, 1973, 27-40.

[3] Brantley, C.L. and Y.R. Osajima. "Continuing Development of Centrally Developed and Maintained Software Systems," IEEE Computer Society Proceedings, Spring, 1975, 285-288.

[4] Brooks, Frederick P., Jr. The Mythical Man-Month. New York: Addison-Wesley, 1975.

[5] Ditri, A.E., J.C. Shaw, W. Atkins. Managing the EDP Function. New York: McGraw-Hill Book Co., 1971.

[6] Gildersleeve, T.R. Data Processing Project Management. New York: Van Nostrand Reinhold Co., 1974.

[7] Gunderman, R.E. "A Glimpse into Program Maintenance," Datamation June, 1973, 99-101.

[8] "Implications of Using Modular Programming," Guide no. 1, J. Hoskyns and Co., Ltd., Hoskyns Systems Research, Inc., 1973.

[9] Khan, Z. "How to Tackle the Systems Maintenance Dilemma," Canadian Data Systems, Mar., 1975, 30-32.

[10] Kosy, D.W. "Air Force Command and Control Information Processing in the 1980's: Trends in Software Technology", U.S. Air Force Project RAND, June, 1974, 70.

[11] Lientz, B.P., E.B. Swanson, and G.E. Tompkins. "Maintenance Questionnaire and List of Respondents", Technical Report, 1976.

[12] Lindhorst, W.M. "Scheduled Maintenance of Applications Software," Datamation, May, 1973.

[13] Mooney, J.W. "Organizing Program Maintenance", Datamation, Feb., 1975.

[14] Nie, N.H. et al. SPSS. New York: McGraw-Hill Book Co., 1975.

[15] "Program Maintenance: User's View", Data Processing, Sept. - Oct., 1973, 1-4.

[16] Riggs, Robert. "Computer System Maintenance", Datamation, Nov., 1969, 227-235.

[17] Stearns, S. "Experience with Centralized Maintenance of a Large Application System," Proc. IEEE Computer Society Conf., Spring, 1975.

[18] Swanson, E. B. "The Dimension of Maintenance", Proc. Second Conf. on Software Engineering, 1976, 492-497.

[19] "That Maintenance Iceburg," EDP Analyzer, Canning Publications, October, 1972.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: Technical report	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): (6) Characteristics of Application Software Maintenance		5. TYPE OF REPORT & PERIOD COVERED: (9) Technical Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): (10) B.P. Lientz, E.B. Swanson, G.E. Tompkins		8. CONTRACT OR GRANT NUMBER(s): (15) N00014-75-C-0266
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Graduate School of Management, University of California, Los Angeles, CA		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: NR 049-345
11. CONTROLLING OFFICE NAME AND ADDRESS: Information Systems Program, Office of Naval Research, Arlington, VA		12. REPORT DATE: (11) December 1976 13. NUMBER OF PAGES: 20 (22 p.)
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report): unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Application software
Maintenance
Enhancements
Productivity

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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analysis indicate that 1) user demands for enhancements and extensions constitute the major perceived problem area, 2) problems of a management nature are viewed in general as more significant than technical problems, 3) the use of technical productivity aids remains limited; however, maintenance programmer productivity is not considered by management to be a major problem.